UNIVERSITY OF ESWATINI

FACULTY OF SCIENCE
Department of Electrical and Electronic engineering

MAIN EXAMINATION 2019

Title of the paper:

Fundamentals of Power and Machines

Course Code: **EEE352**
Time allowed: **Three Hours**

Instructions:

1. To answer, pick any 5 questions from the 6.
2. The answer must be written in the space provided in the question book; those in elsewhere considered invalid. Use the answer book as a scratch pad. Both question and answer book must be handed-in and marked with name and ID.
3. This paper has 7 pages, including this page.

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PERMISSION HAS BEEN GIVEN BY THE INVIGILATOR

Q1(20 pts): Draw a one-line diagram to show the typical structure of a distribution system, which down to the loads. Mark all necessary components. The system, from 11.4 Kv, 3-φ source, is including a transformer 11.4K/380 V, Δ-Y, with 4% pu series impedance and 4 loads at 220V of 60A, 40A, 40A, and 20A. Protective breakers and metering are necessary. and mark all spec values (2 pts for each component or group of components of the same level)

Q2(20 pts): The general transformer equivalent circuit is shown in Fig. Q2-1.

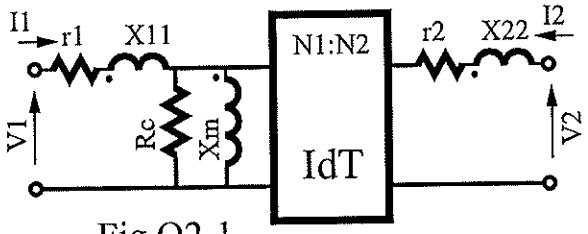

Fig Q2-1

(i). Give the definition of a PT (2 pts), modify the Fig. Q2-1 to make a PT equivalent circuit (5 pts), and give the limit of the load of this PT (3 pts).

(ii). Give the definition of a CT (2 pts), modify the Fig. Q2-1 to make a CT equivalent circuit (5 pts), and give the limit of the load of this CT (3 pts).

Q3(20 pts): What have you seen during the field trip to the power plant and the distribution sub-station.

(i)(6 pts). Generator specs:

(ii)(6 pts). Step-up transformer in the switch yard

(iii)(8 pts). Equipments in the sub-station and their specs.

Q4(20 pts):

(i)(4 pts) Describe the differences between a switch and a breaker?

(ii)(4 pts) Describe the differences between a synchronous generator and a synchronous motor.

(iii)(12 pts) List power source quality factors, most concerned to the base users, 4 items least (3 pts each). Following the list, a key definition or explanation is required.

Q5(20 pts): A rotating magnetic field, shown in Fig. Q5-1, has two coils: Ch has a current i_h producing a field Bh, and Cv has a current i_v producing a field B_v. Each is energized respectively by the current:

$$i_h = I \cdot \cos.\omega t \qquad i_v = I.\sin.\omega t$$

(i)(15 pts) Prove the resultant magnetic field will rotate at an angular speed ω; ie, $\theta_o = \omega t$.

(ii)(5 pts) Find out the rotating is CCW or CW.

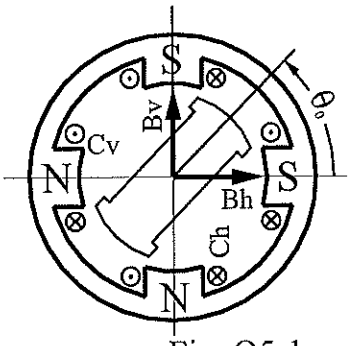

Fig. Q5-1

Q6(20 pts): For the power system shown in Fig. Q6-1,

(i)(10 pts). Solve the no load voltage V_{NL}, the full load voltage V_{FL}, and calculate the voltage regulation.

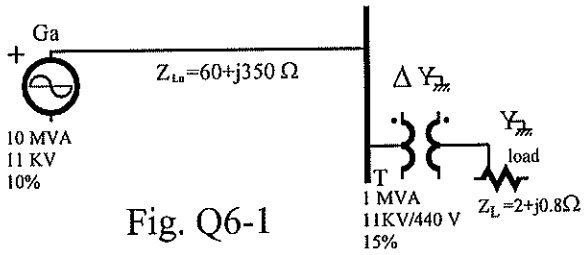

Fig. Q6-1

(ii)(10 pts). Calculate the total power consumed by the load: S, P, Q, and power factor.

(note: the φ voltage of 440 V is 254 V)